Screening apparatus

This invention relates to a screening apparatus for separating fiber suspensions, preferably pulp suspensions. The screening apparatus comprises a screen housing and centrally enclosed therein a stator, which is surrounded by a screen means co-axial with the stator and rotary about a rotor shaft. The screen means divides the interior of the screen housing into a screen chamber between the screen housing and screen means and an accept chamber between the screen means and stator. The screening apparatus further comprises an inlet for the pulp suspension to the screen chamber, a reject outlet for reject from the screen chamber and an accept outlet for accept from the accept chamber.

Such screening apparatus is used at the coarse and fine screening of pulp suspensions, preferably for fractionating or separating impurities and other impurities not desired to be included in the final product, such as shives, coarse particles, scrap, stones or undigested or not refined chip bits. The screening apparatus then usually is pressurized.

The pulp suspension to be screened is introduced via the inlet to the screen chamber where the approved fraction, the accept, flows through the rotating screen means. The accept is thereafter discharged through the accept outlet. In order to create suction pulses, pulse elements are provided on the stator. The pulse elements are designed as wings extending in axial direction along the entire stator and screen means. The wings are arranged in such a manner, that the pulp suspension can pass between the wings and stator.

The portion of the pulp suspension which does not pass through the screen means (the reject), is discharged via a reject outlet, which usually is located as a radial outlet at the lower portion of the screen housing.

A well-known problem in this connection, for example at the screening of papermaking pulp, is that the pulp suspension in the screen chamber, relatively close to the reject outlet, assumes a pulp concentration higher than that of the pulp suspension relatively

close to the inlet. This is due to the fact that at screening the liquid in the pulp suspension is transported to and through the screen means at a higher speed than the fibers in the pulp suspension. Thus, a dewatering of the pulp suspension is obtained, which results in that the suspension increasingly is thickened the closer at the reject outlet it arrives. Thereby a thickened reject layer is obtained at the screen means near the reject outlet. The thickening increases still more at a relatively low flow in the reject outlet, i.e. at low reject discharge. At heavy thickening a problem arises, viz. the moment transfer between screen housing and screen means at the thickened pulp suspension. This has a braking effect on the screen means, which causes increased energy consumption for rotating the screen means and may even result in stopping the screen means. The thickening can also cause plugging and, thereby, problems with removing the reject via the reject outlet. Today, it is desired to be able to screen pulp suspensions with as high a pulp concentration as possible. The thickening, thus, becomes a great problem, because the pulp suspension already at its introduction to the screen chamber has a high concentration.

The present invention has the object to show an apparatus, which to a great extent reduces or eliminates the stated problems with thickening.

This object is achieved by a screen apparatus of the kind described in the introductory portion, which comprises at least one barrier/pulse element. The barrier/pulse element is located on the stator and extends in axial direction substantially along the entire stator and entire screen means and is capable upon rotation of the screen means to create in addition to suction pulses also pressure pulses to the pulp suspension in the screen chamber. The pressure pulses produce a substantially radially directed pump effect to the screen means and outward in the pulp suspension in the screen chamber, so that the reject continuously and already directly after the start of the screen passes through the reject outlet. Consequently substantially no thickened reject layer is built up, and the risk of plugging is reduced considerably. It is, thus, possible to screen at higher pulp concentrations without disturbances.

The barrier/pulse element, contrary to the pulse elements of prior art, is attached tightly to the stator and extends from the stator outward to the screen means, so that the accept substantially is prevented from tangentially passing the barrier/pulse element. The accept is thereby forced either to move axially to the accept outlet or due to the pressure pulse radially to the screen means, whereby the screen means is cleaned, and the pulp suspension in the screen chamber is mixed with that accept portion, which passes out through the screen means.

In addition to the aforementioned advantages, such a screen has proved to yield a uniform quality of the accept even when the inject has a non-uniform quality with regard to the content of, for example, shives, coarse particles, knots, incompletely digested or unrefined chip bits.

The characterizing features of the invention are apparent from the attached claims.

The invention is described in greater detail in the following, with reference to the accompanying drawings illustrating an embodiment of the invention.

Fig. 1 shows a screening apparatus according to the invention,

Fig. 2 is a radial section of the screening apparatus according to the invention,

Fig. 3 shows an enlargement of the barrier/pulse element in Fig. 2,

Fig. 4 shows another design of the barrier/pulse element in Fig. 3,

Figs. 5 and 6 show other embodiments of the barrier/pulse element.

The screening apparatus in Fig. 1 comprises a pressurized screen housing 1 with an upper portion 2, which has a greater diameter than the lower portion 3 of the screen housing. In the upper portion 2 of the screen housing 1 a substantially tangential inlet 4 is located for the fiber suspension to be separated, which in this example is a pulp

suspension. An accept outlet 5 for the accept is located substantially tangentially in the lower portion 3 of the screen housing 1. A reject outlet 6 is located substantially axially and downward directed in the lower side of the upper portion 2, but radially seen outside the lower portion 3.

In the upper portion 2 of the screen housing a rotation symmetric screen means 7 is located so that it is rotary about a vertical rotor shaft 11. A stator 8 is located radially seen inside the screen means 7. The screen means 7 and stator 8 are arranged co-axially. The screen means 7 defines the upper portion 2 of the screen housing 1 in a screen chamber 9 between the screen housing 1 and screen means 7 and an accept chamber 10 between the screen means 7 and stator 8.

The screen means 7 can be of any type of screen means comprising screen apertures of a suitable size for passing through the desired portion of the pulp suspension. The screen means, for example, can have slits with openings between 0.1 mm and 0.5 mm, or holes with hole diameters between 0.1 mm and 12 mm, and at coarse screening preferably 8–10 mm.

In the lower portion 3 of the screen housing a lower accept chamber 13 is located which constitutes an extension of the accept chamber 10.

On the stator 8 four barrier/pulse elements 12 are located symmetrically. The barrier/pulse elements 12 can be one or more in number, but suitably 2–8 and most suitably 3-4, and advantageously arranged symmetrically in the circumferential direction of the stator 8.

The barrier/pulse elements 12 extend in axial direction along the entire stator and are attached tightly to the stator 8. They extend from the stator 8 and out to and along the entire screen means 7. The distance between the barrier/pulse elements 12 and screen means 7 shall be so short that the accept substantially does not pass therebetween. A suitable minimum distance between the barrier/pulse element 12 and screen means 7 is 4 to 10 mm. The accept chamber 10 is thereby divided into a number of smaller

accept cells 10_1, 10_2, 10_3 and 10_4, each of which communicates with the lower accept chamber 13 in the lower portion 3 of the screen housing and thereby with the accept outlet 5.

At the embodiment shown, the barrier/pulse elements 12 extend in axial direction straight downward from above. In order to assist in feeding the accept in the accept cells 10_1, 10_2, 10_3 and 10_4 to the accept outlet 5, the barrier/pulse elements 12 can instead be designed so that they axially seen in the direction to the accept outlet 5 (in this example downward from above) deflect in the rotation direction of the screen means. Hereby the accept is guided more easily to the accept outlet 5, and a lower pressure drop above the stator 8 is obtained.

The pulp suspension to be separated is fed via the inlet 4 into the screen chamber 9. The rotating screen means 7 transfers mechanically energy to the pulp suspension in the screen chamber 9, which thereby follows the rotation direction of the screen means at the same time as it moves downward and thereby in a screwing movement moves down through the screen chamber 7. When the screen means rotates, a suction pulse arises on the rear side of the barrier/pulse element 12, seen in the rotation direction. The accepted fraction of the pulp suspension flows thereby through the rotating screen means 7 and into one of the accept cells 10_1, 10_2, 10_3 or 10_4. The main portion of the accept flows thereafter down to the lower accept chamber 13 and out through the accept outlet 5.

During the rotation of the screen means 7, the accept in the accept cells 10_1, 10_2, 10_3 and 10_4 partially follows along in the rotation of the screen means 7. When the accept approaches the barrier/pulse element 12, portions of the accept are pressed back out through the screen means 7 and out into the screen chamber 9. Thereby the screen means 7 is cleaned of possible cloggings, and the pulp suspension in the screen chamber 9 is mixed with the accept fraction from the accept chamber 10. Hereby too heavy a thickening of the pulp suspension in the screen chamber 9 is prevented, and at the same time also a rotation of the accept in the same direction in the accept chamber 10 is prevented.

The portion of the pulp suspension in the screen chamber 9 which cannot pass through the screen means 7, continues to move in a screwing movement down through the screen chamber 9 and out through the reject outlet 6.

The barrier/pulse element 12, in order upon rotation of the screen means 7 to produce strong pressure pulses to the pulp suspension in the screen chamber 9, suitably is designed as shown in Fig. 3. Facing toward the screen means 7, the barrier/pulse element 12 has a pulse surface 14, where the distance between the pulse surface 14 and screen means 7 descreases in the rotation direction of the screen means to the point where the barrier/pulse element 12 is located closest to the screen means 7. When the accept approaches the barrier/pulse element 12, it is thereby forced by the shape of the barrier/pulse element 12 out through the screen means 7 and out into the screen chamber 9.

In Fig. 4 the same design of the barrier/pulse element as in Fig. 3 is shown, but here the barrier/pulse element is not attached to the stator 8, but formed as one unit with the stator 8, which, of course, also is possible.

Fig. 5 shows a different embodiment of the barrier/pulse element 12, which has a smaller pulse surface 14 than the barrier/pulse element in Fig. 3. This barrier/pulse element 12, thus, does not produce equally strong pressure pulses. Fig. 6 shows another different embodiment of the barrier/pulse element 12, which is designed as a curved metal sheet. The barrier/pulse element, of course, can also be designed in other ways.

The portion of the barrier/pulse element 12 which faces the rotation direction of the screen means 7, should be designed so that it assists in guiding the accept out to the screen means 7. This surface should, seen radially from the inside of the stator 8 and out to the screen means, be radial as in Fig. 5 or deflected in rotation direction of the screen means 7 as in Fig. 6.

At the embodiment shown, the stator 8, screen means 7 and screen housing 1 outside the screen means 7 all have the form of a cylinder. One or several of the stator, screen

means and, respectively, screen housing outside the screen means can also, for example, have conic shape, with different or equal angle relations relative one another. By forming the screen housing outside the stator and, respectively, the stator cylindric or conical, it is possible to change the accessible space between them. By changing, for example, the screen means from cylindric to conical shape, the relation between accessible space in the screen chamber and, respectively, accept chamber can be changed. If accessible space thereby in axial direction becomes different, the space in the accept chamber should increase in the direction to the accept outlet, and the space in the screen chamber should be greatest at the inlet.

The accept outlet, reject outlet and inlet, of course, can be located in places in the screening apparatus other than indicated at the embodiment shown. The accept outlet, for example, can be located in the upper portion of the screening apparatus, and the inlet in the lower portion thereof. The reject outlet suitably is located in the lower portion of the screening apparatus, in order to utilize the gravity at the separation of heavy foreign particles.

At a variant of the stator, in addition to barrier/pulse elements it can also be provided with pulse elements of conventional type. It can, for example, be provided with 4 barrier/pulse elements and between them with usual pulse elements, where the accept can pass between the wing and stator.

A screening apparatus according to the invention, of course, can be used separately as well as in combination with other screens in a common screen housing.

The invention, of course, is not restricted to the embodiment shown, but can be varied within the scope of the claims with reference to description and Figures.